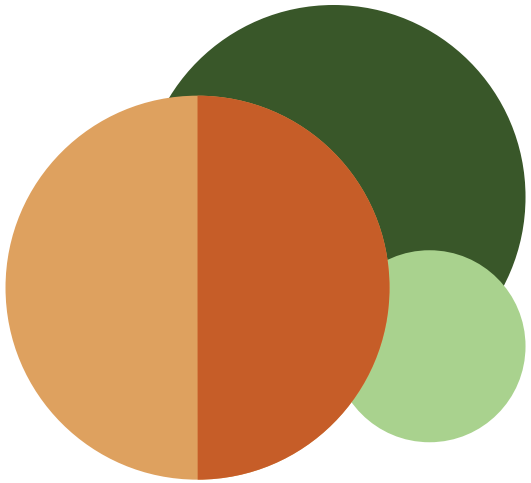
# I-FARM University Learning Series

## Smart Grazing: AI integration into grazing management

**November 14th, 2024**

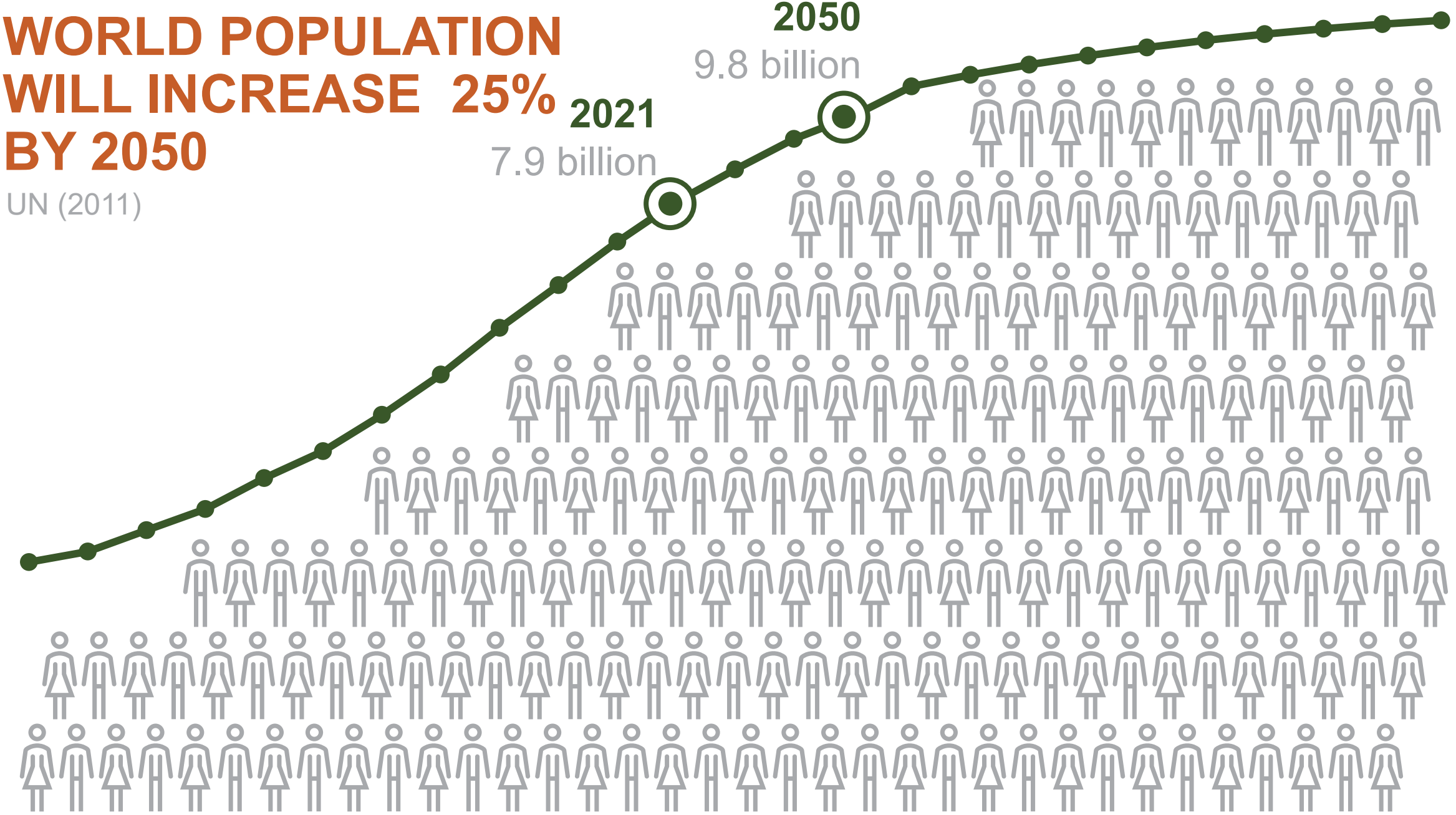
i-FARM TESTBED



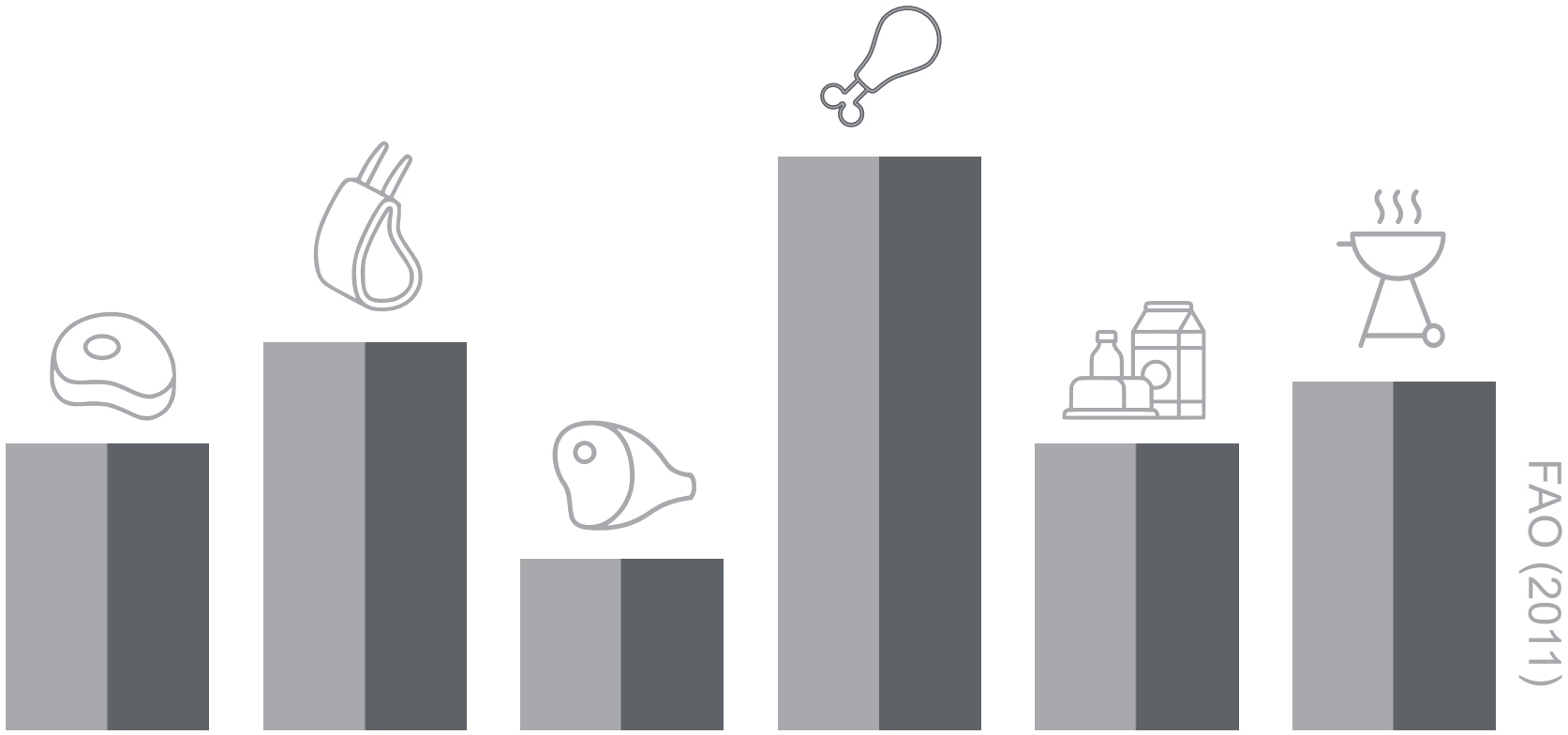
# 1. THE PROBLEM

# WORLD POPULATION WILL INCREASE 25% BY 2050

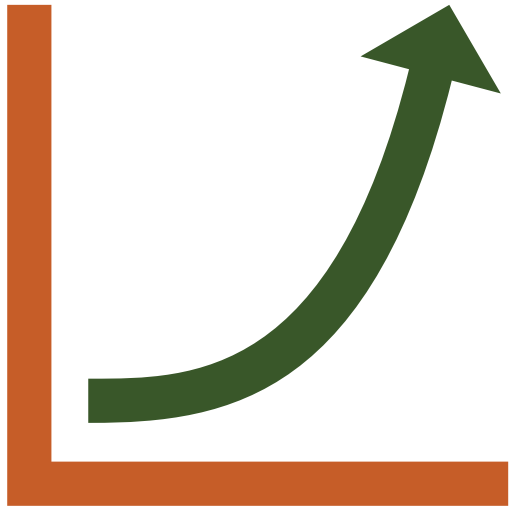
UN (2011)



# Animal Products Consumption Increase by 2050

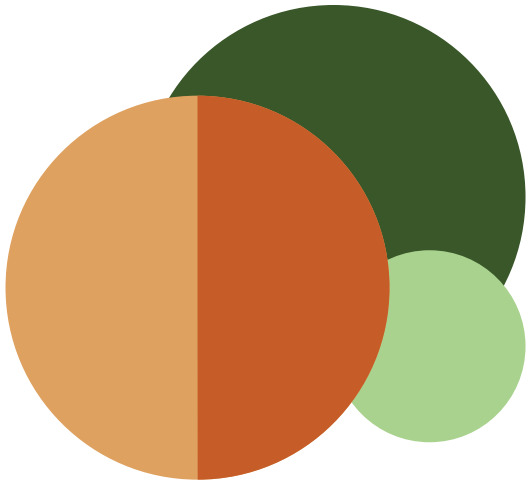


# Challenges



INCREASE EFFICIENCY WHILE…

- MAINTAINING ANIMAL HEALTH
- IMPROVING ANIMAL WELFARE
- IMPROVING ENVIRONMENTAL SUSTAINABILITY
- HELPING FARMERS
- KEEPING SYSTEM PROFITABLE



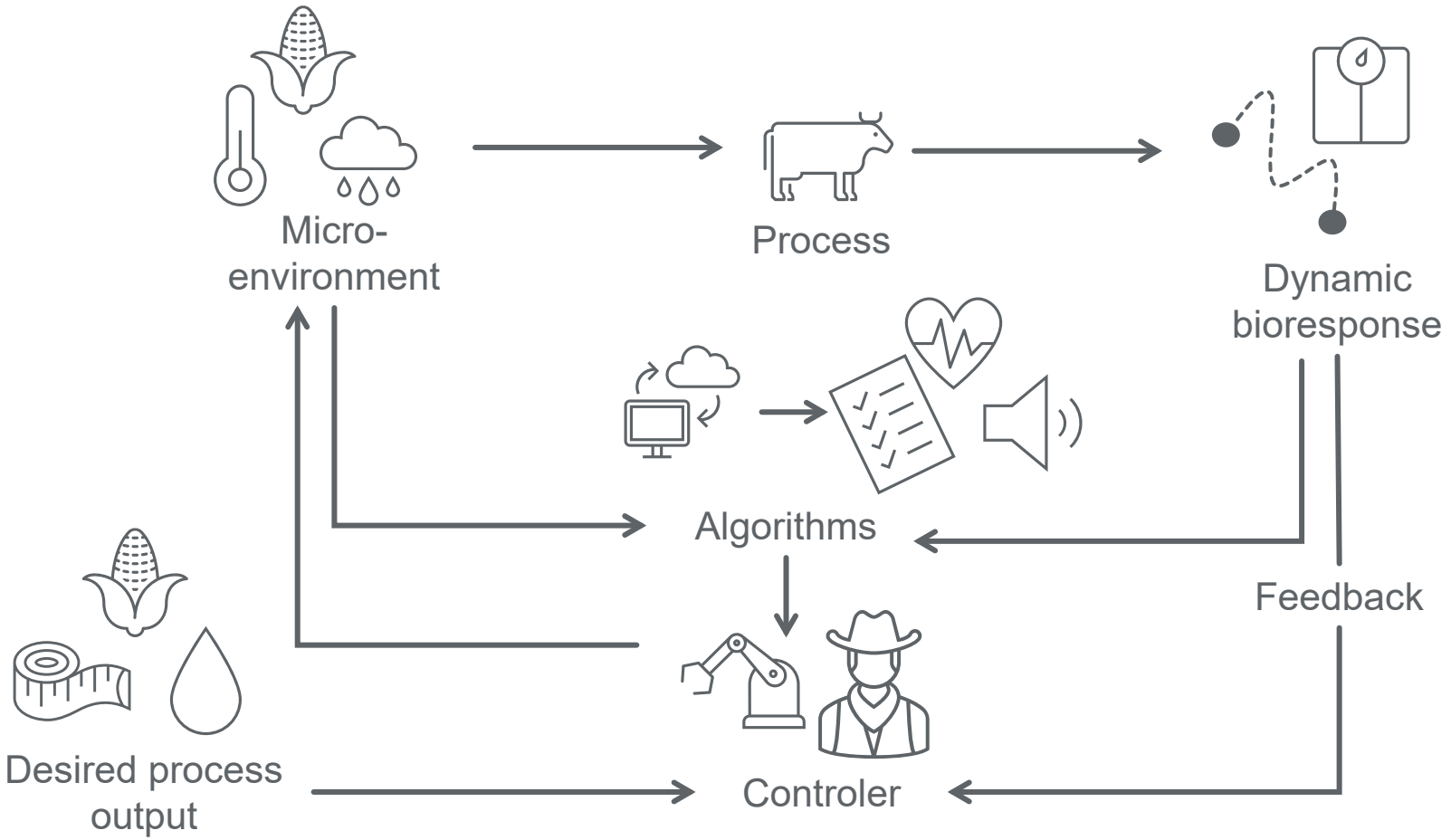
# 2. PRECISION MANAGEMENT

“

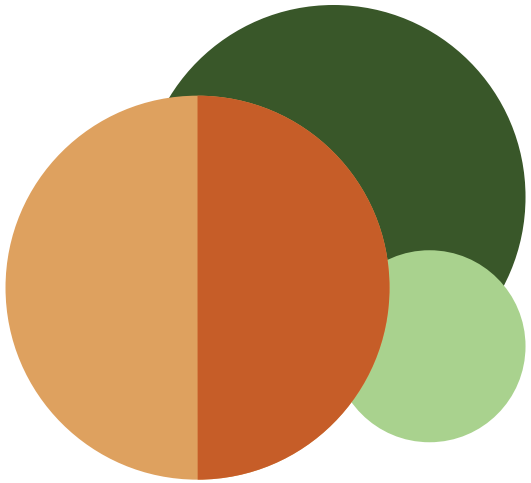
**Management of individual animals by continuous, automated, and real-time monitoring of health, welfare, production, reproduction, and environmental impact.**

BERCKMANS (2019)

# How?



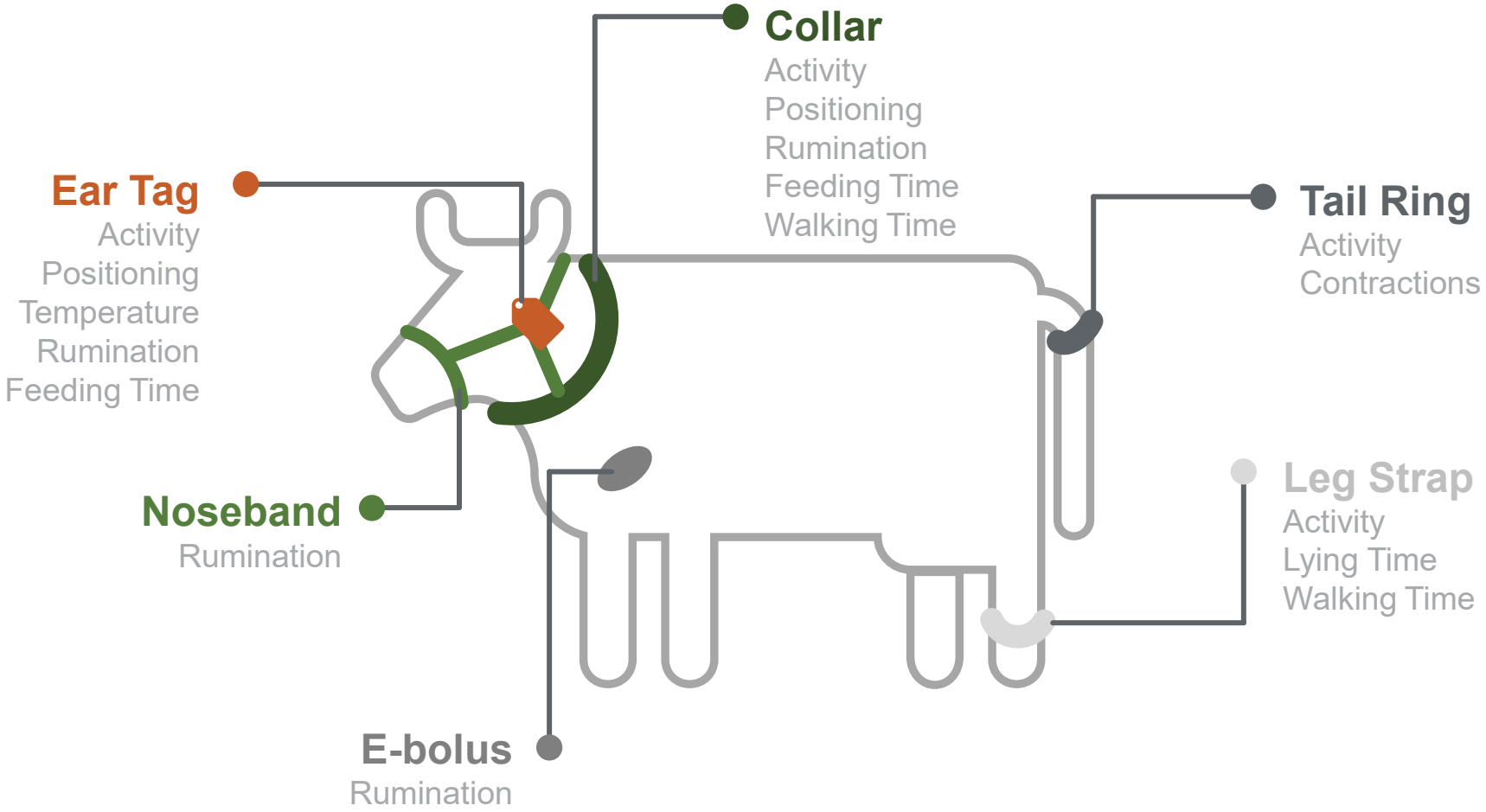

Adapted from M3-Biores KU Luven



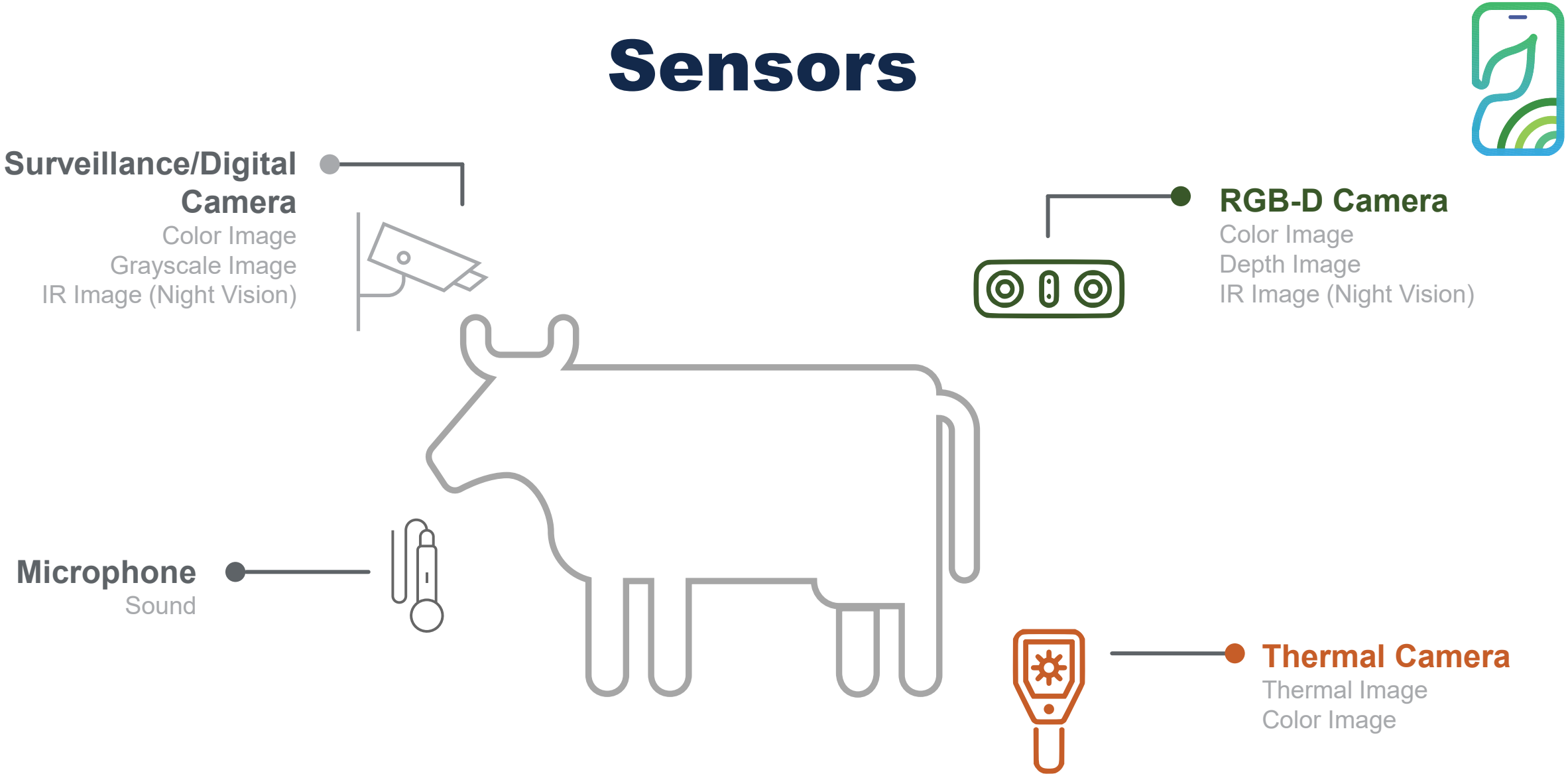
# 3. DEVELOPING TOOLS


“You can’t manage what you can’t measure.
– Peter Drucker

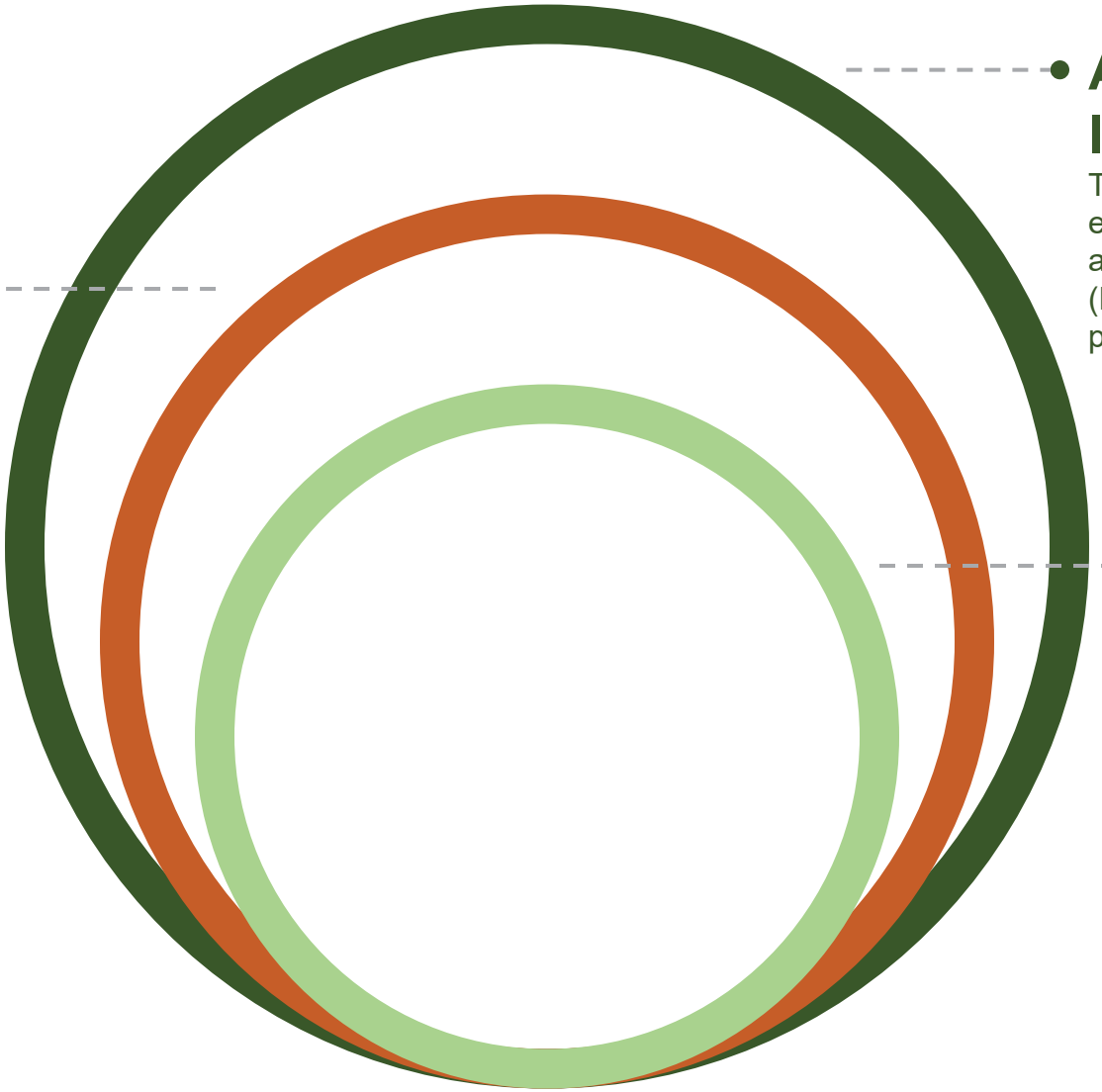
# Sensors


Collar
Activity
Positioning
Rumination
Feeding Time
Walking Time
Ear Tag
Activity
Positioning
Temperature
Rumination
Feeding Time
Tail Ring
Activity
Contractions
Noseband
Rumination
Leg Strap
Activity
Lying Time
Walking Time
E-bolus
Rumination

# Sensors


Surveillance/Digital Camera
Color Image
Grayscale Image
IR Image (Night Vision)
RGB-D Camera
Color Image
Depth Image
IR Image (Night Vision)
Microphone
Sound
Thermal Camera
Thermal Image
Color Image

# Artificial Intelligence and Machine Learning



## ARTIFICIAL INTELLIGENCE

The broad group of techniques enabling machines to mimic aspects of human intelligence. (Ex. Robotics, natural language processing, machine vision, etc)

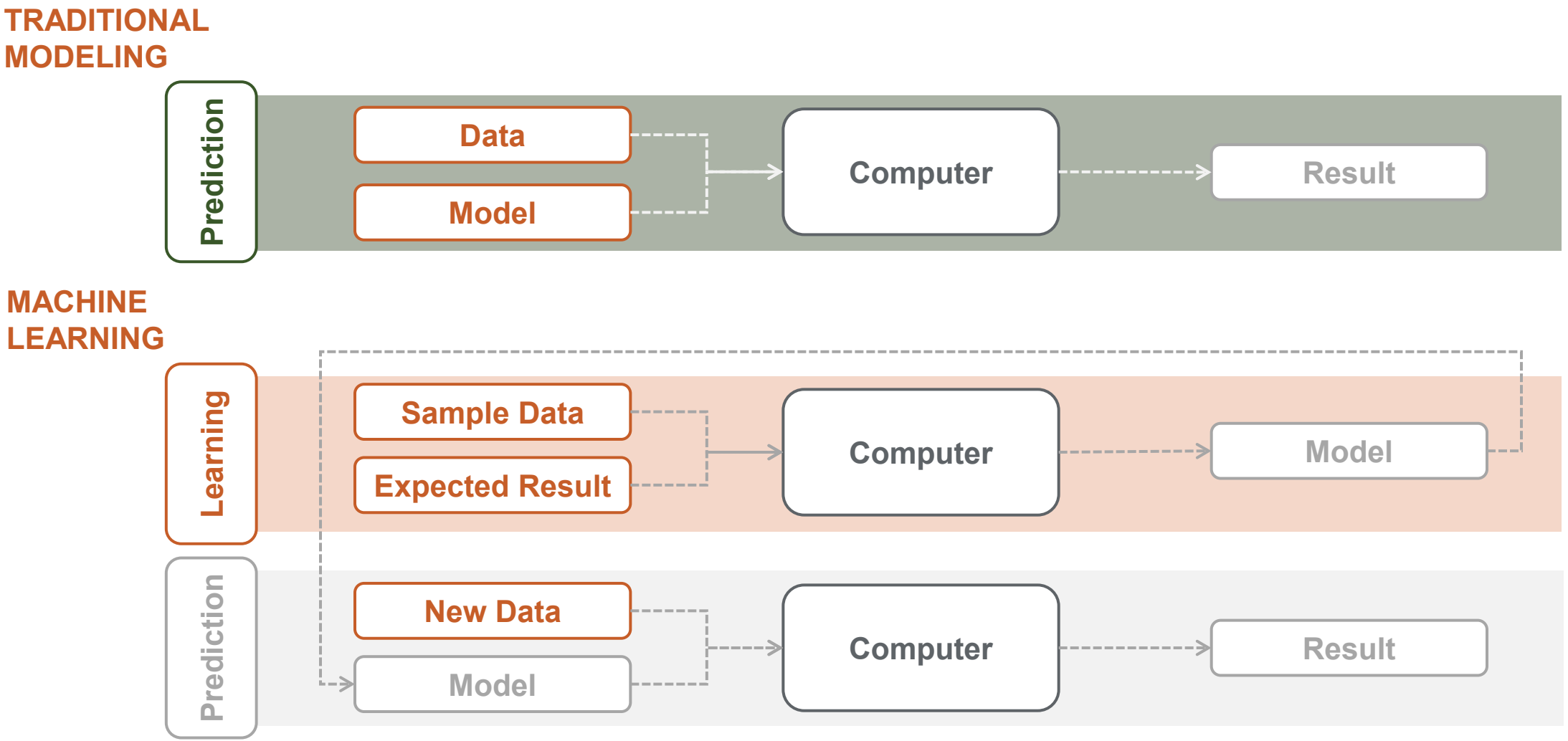
## MACHINE LEARNING

Its goal is to enable computers to learn on their own. Algorithms that improve on tasks through experiences and have the ability to learn without continuous programming.

## DEEP LEARNING

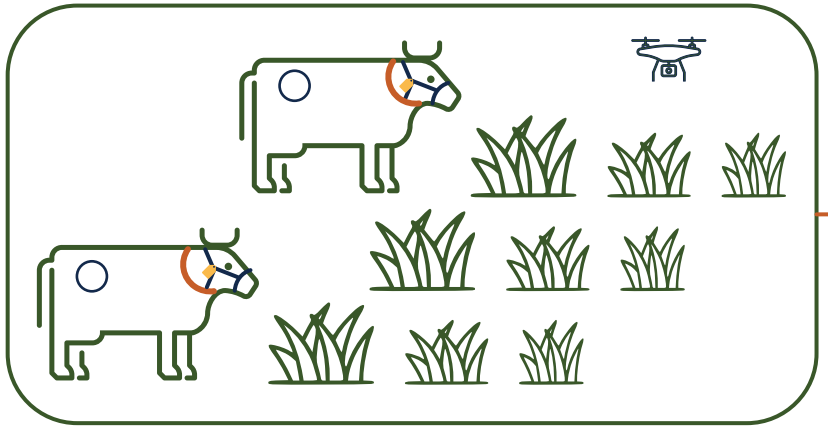
Machine learning subset that uses multilayered neural networks to learn from large amounts of data.

# Machine Learning vs Traditional Programming

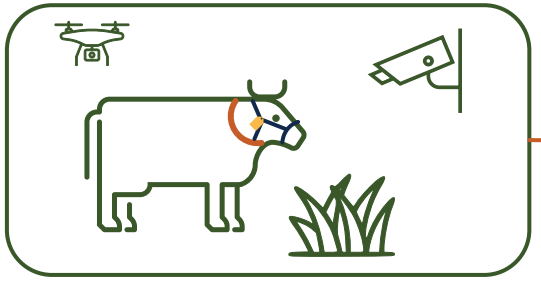


# EXAMPLES

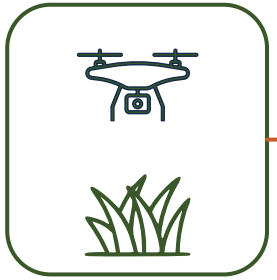
# Precision Grazing
## *Feed Intake Prediction*



Forage disappearance + Rumen content



Sensor streams and manually annotated behavior



Crop characteristics + Geographical location

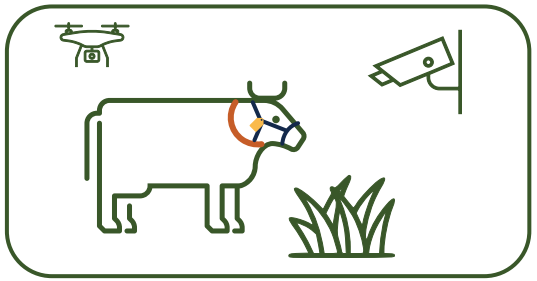
Intake per bite estimation

ML models to predict number of bites

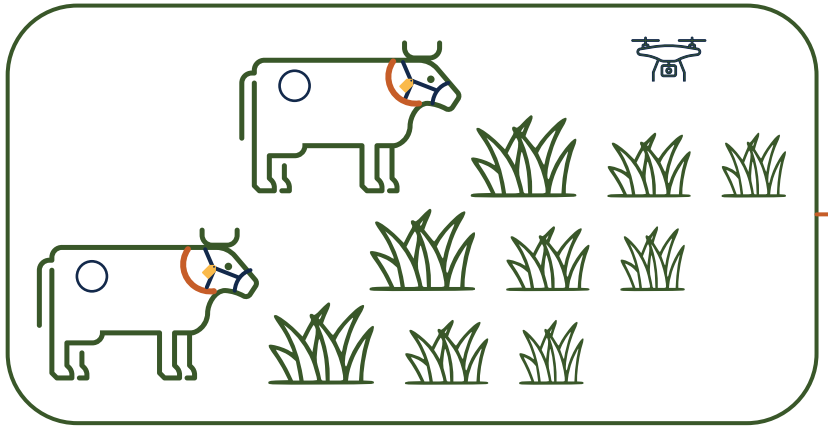
Intake prediction + Geographical location of animals

Quantity and quality of ingested forage per animal

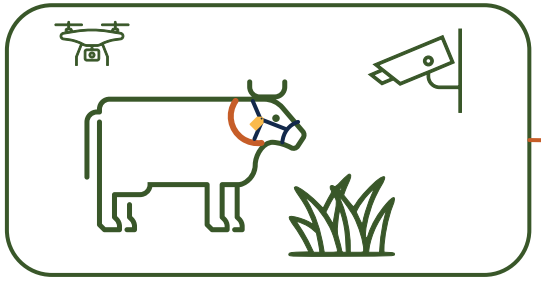
# Sensor streams and manually annotated behavior



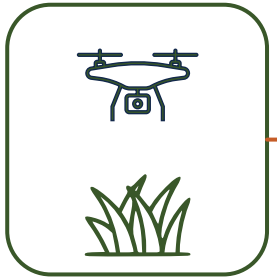
# Precision Grazing
## *Feed Intake Prediction*



Forage disappearance + Rumen content



Sensor streams and manually annotated behavior



Crop characteristics + Geographical location

Intake per bite estimation

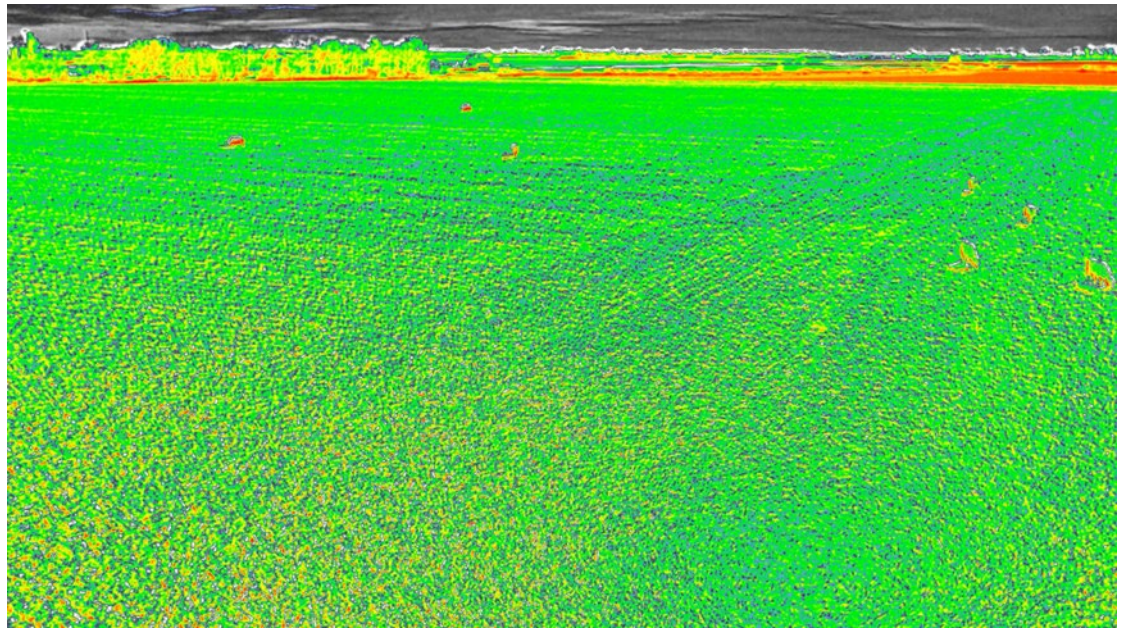
ML models to predict number of bites

Intake prediction + Geographical location of animals

Quantity and quality of ingested forage per animal

# Crop characteristics + Geographical location

RGB

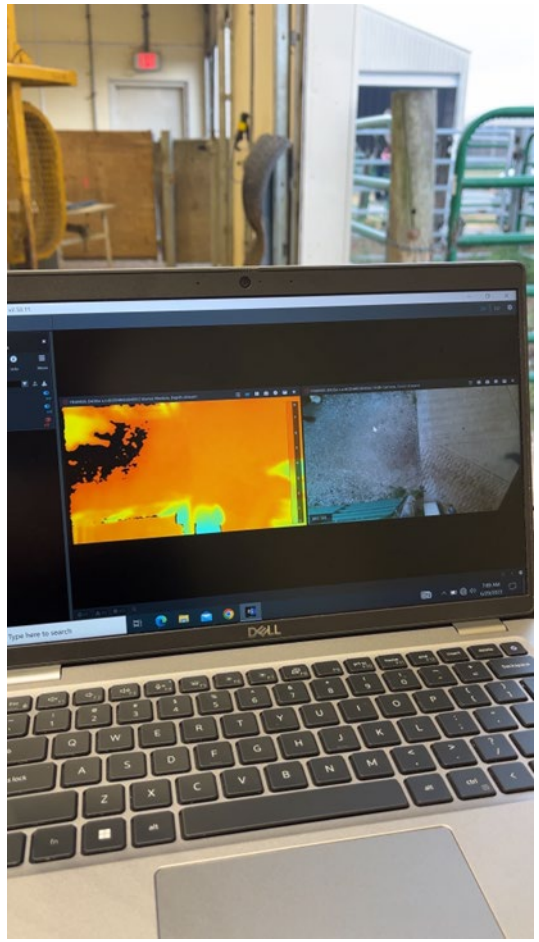


Multispectral

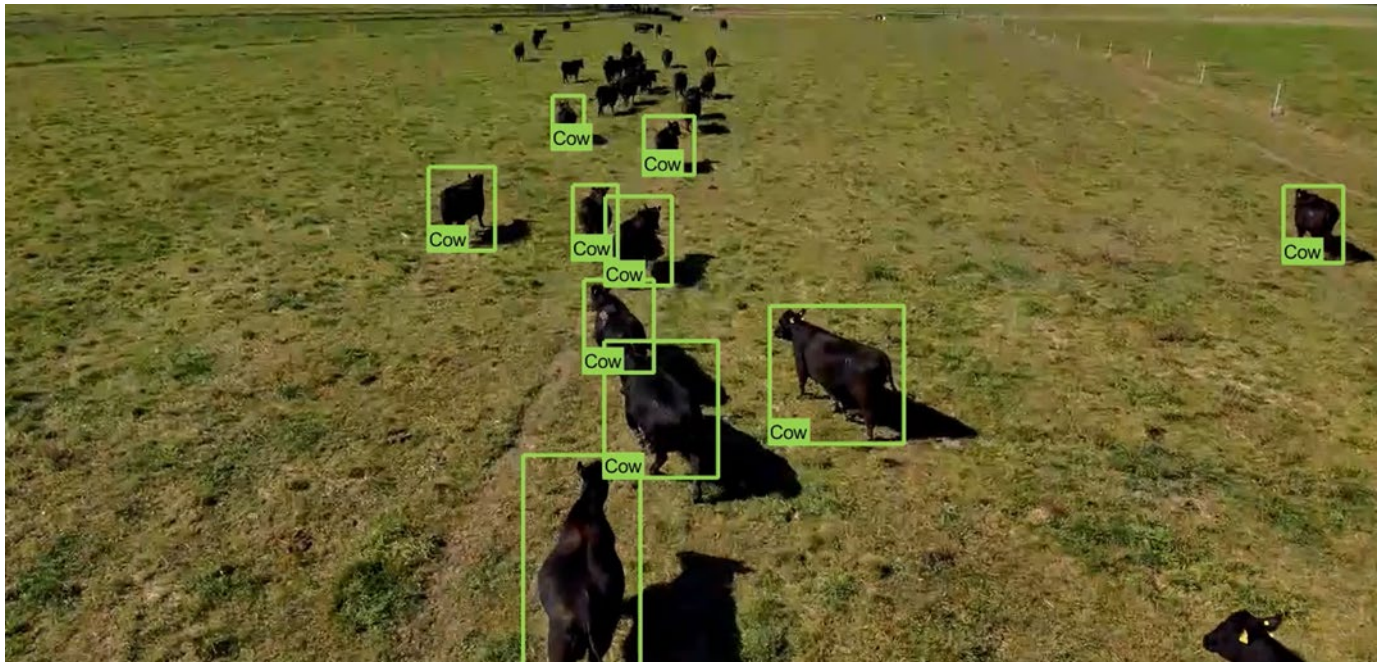
# Crop characteristics + Geographical location

Forage height estimation

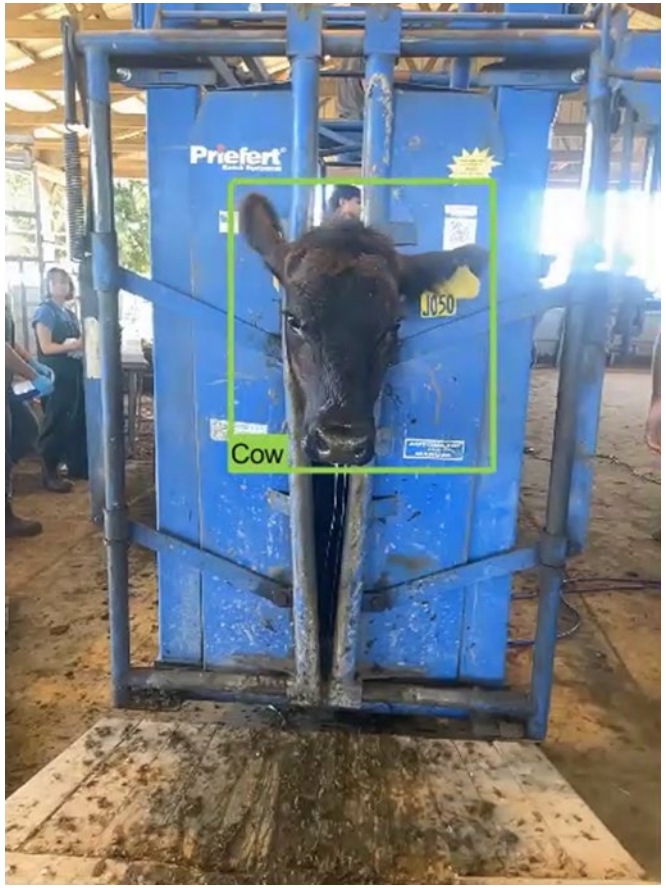
# Precision Grazing
## *Animal Monitoring*



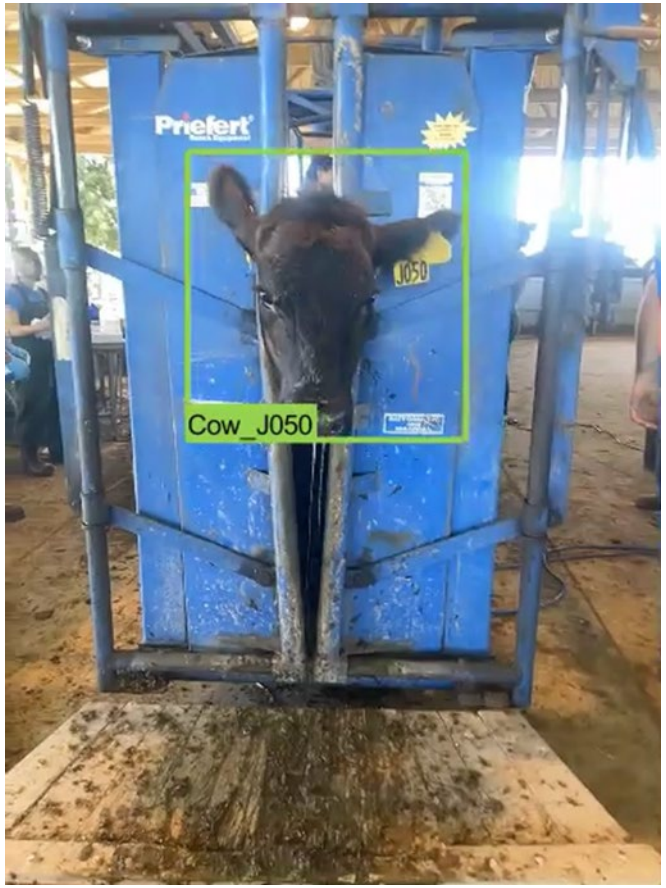
**Indoor to Outdoor**
Weight
BCS
Counting
Identification



# Animal Monitoring
## *Identification*



# Animal Monitoring
## *Identification*



# Animal Monitoring
## *Identification*

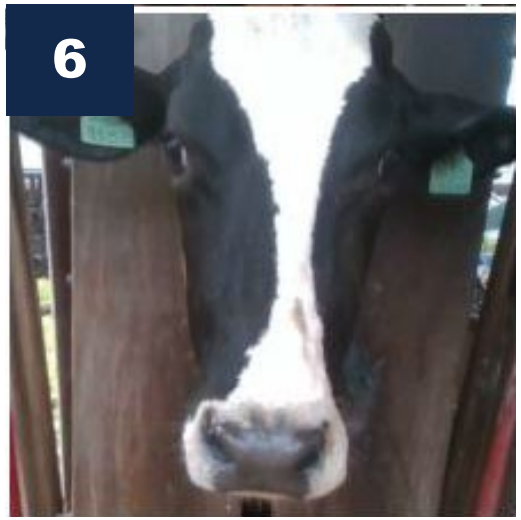
Original image

Cropped face

Blur ID

# Animal Monitoring
## *Identification*


Nelore



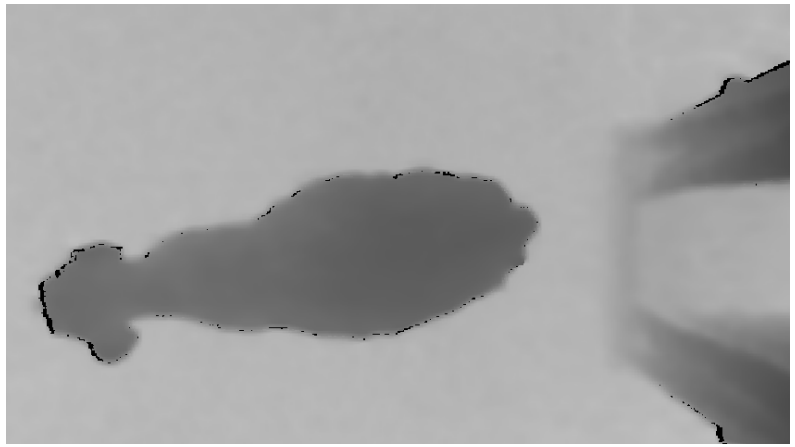

Girolando


Angus


Holstein

# Animal Monitoring
## *Body Weight + BCS*

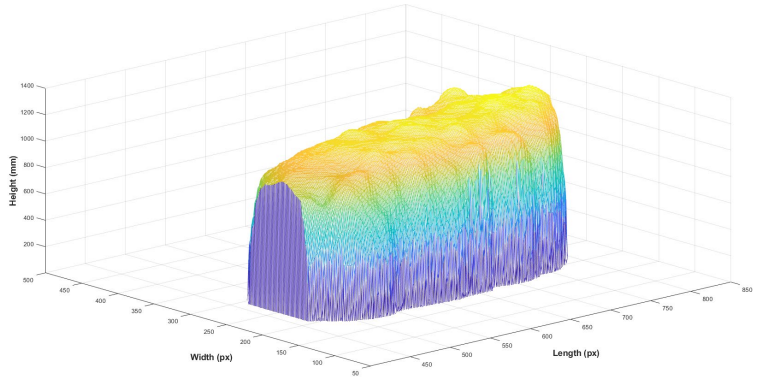
# Animal Monitoring
## *Body Weight + BCS*



Raw Image

Selected Animal

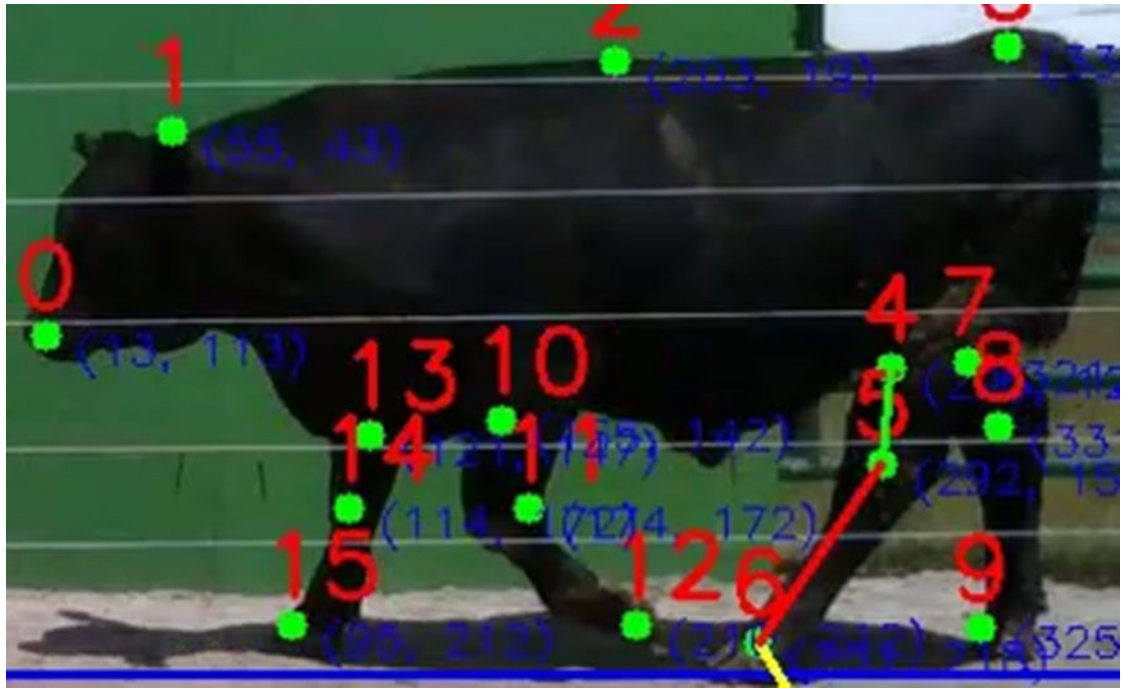
Without head




3D Shape

# Animal Monitoring
## *Gait + Activity Level*

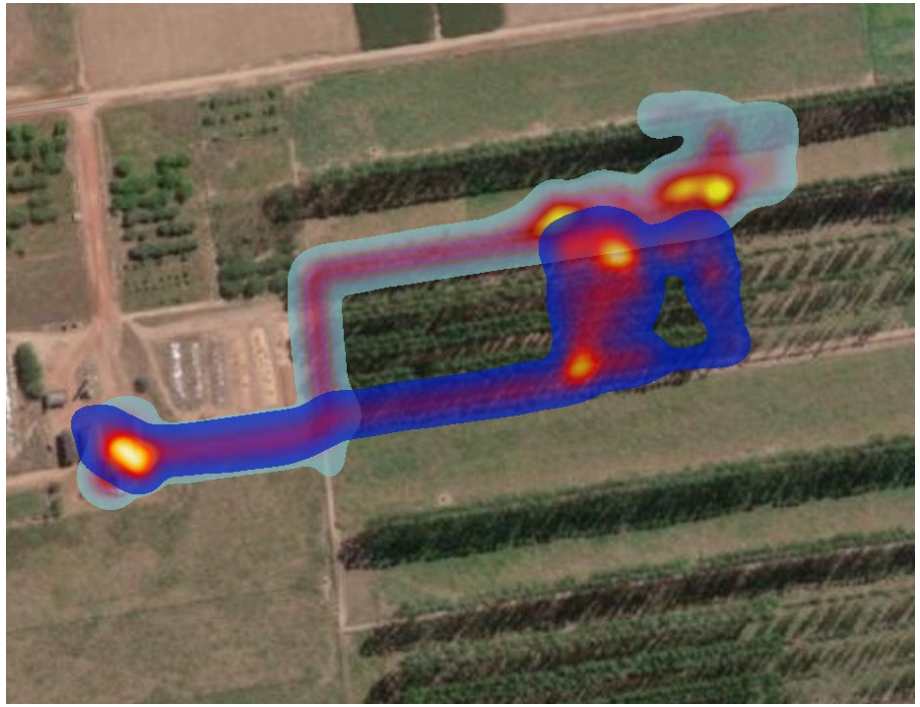

Pose Detection




Step Angle Detection

# Animal Monitoring

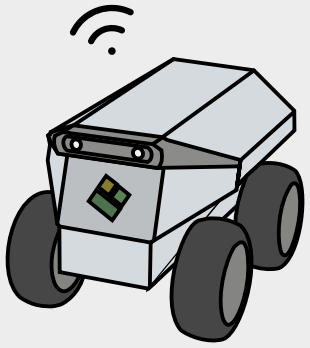
*Indoors → Outdoors*



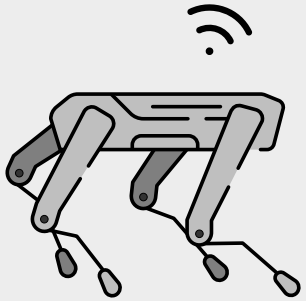
**Wearable GPS + Drone**

# Animal Monitoring

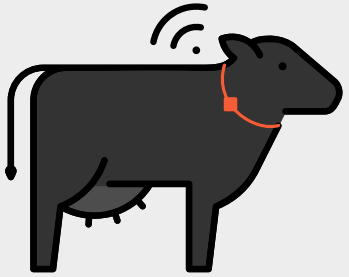
*Indoors → Outdoors*



**Wheeled Robots**
Equipped with RGB-D sensors and GPS.

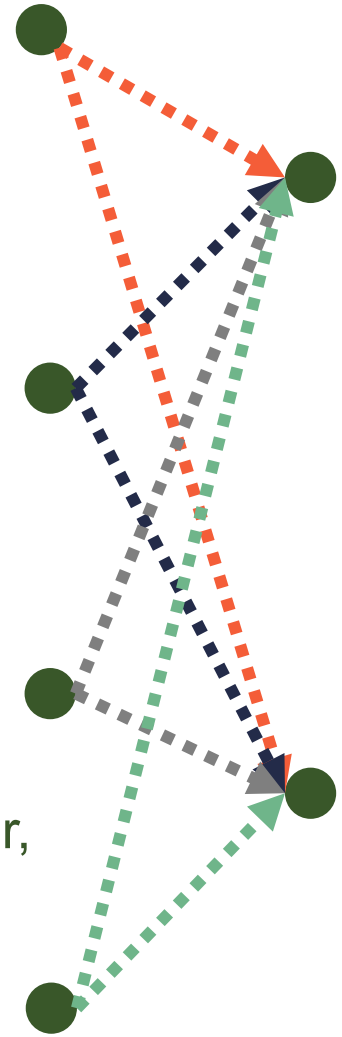


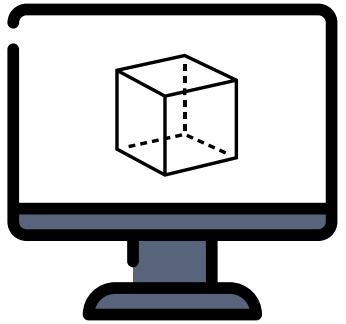
**Robot Dogs**
Equipped with RGB-D sensors and GPS.



**Collars**
Equipped with GPS, accelerometer, speaker, and electrical shocker.

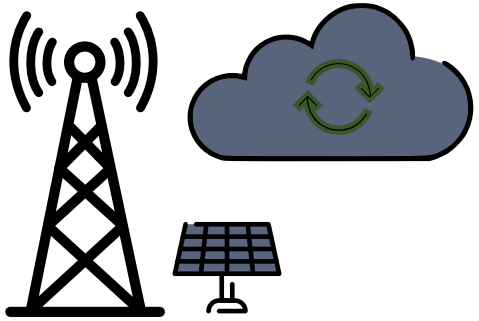
**UAVs**
Equipped with RGB-D sensors, GPS, and multispectral camera.





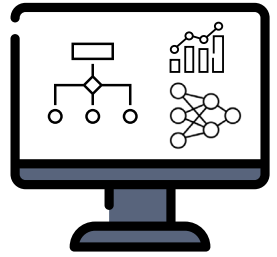
**Simulation Engine**

**Data + models**



**Communication Network**

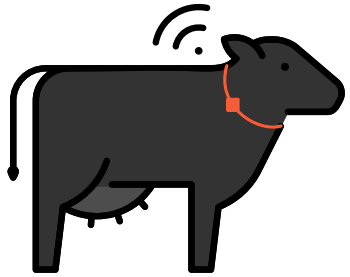
**Data**



**Machine Learning Algorithms**

**Decision Support System**

**Human Decision**



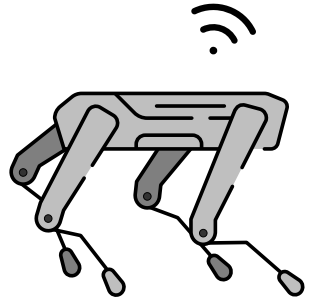
**Animal Care Decision**

Based on animal behavior and physical condition

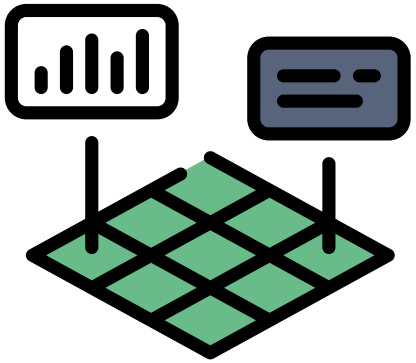
**+**

**Rotation Decision**

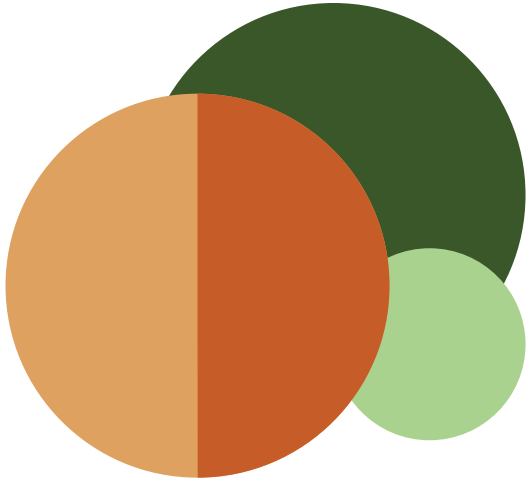
Includes when and where to move animals



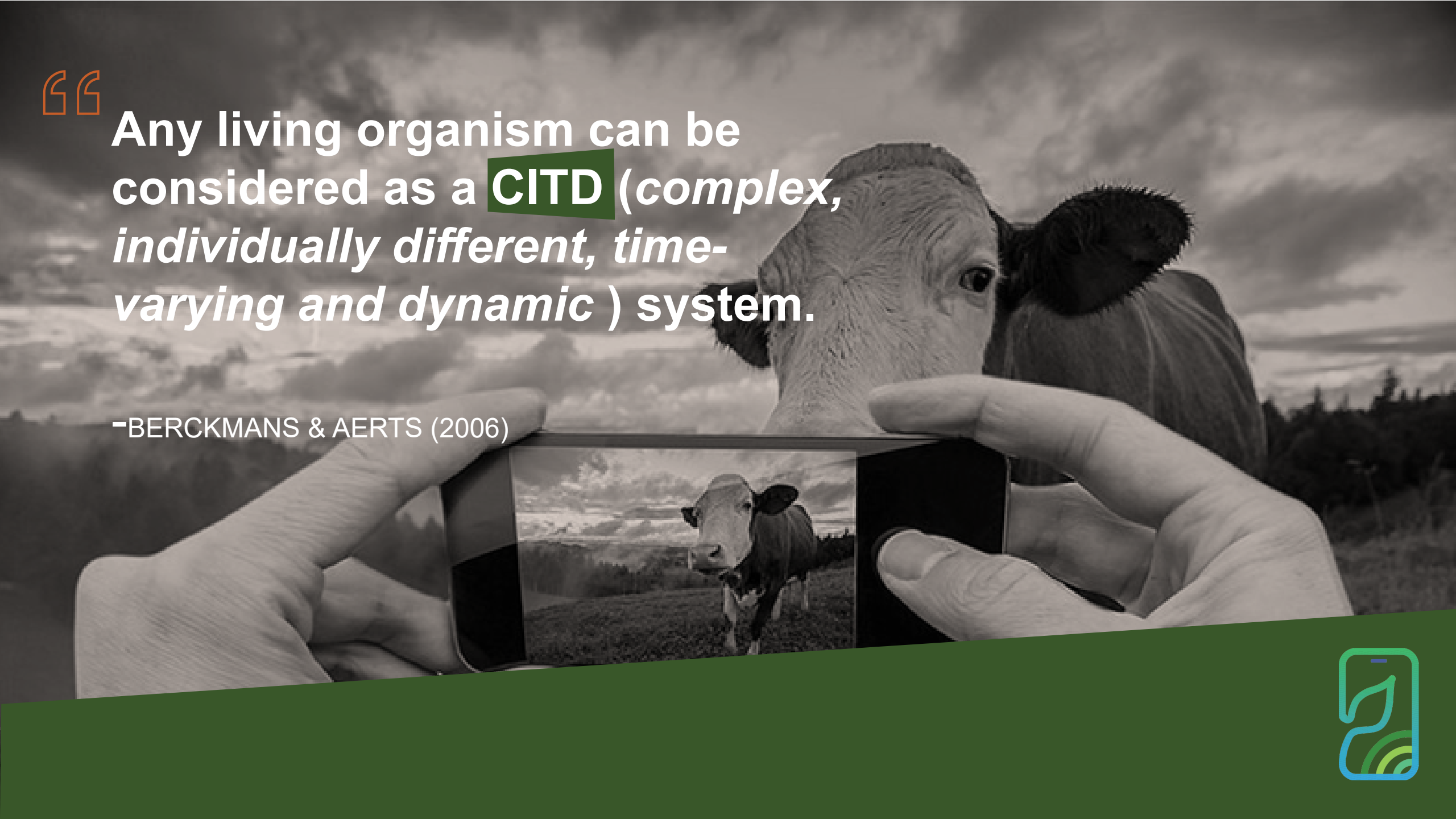
**Automated Herding**



**Adjusted Virtual Fence Boundaries**



# 4. CHALLENGES AND OPPORTUNITIES



**Any living organism can be considered as a CITD (*complex, individually different, time-varying and dynamic* ) system.**

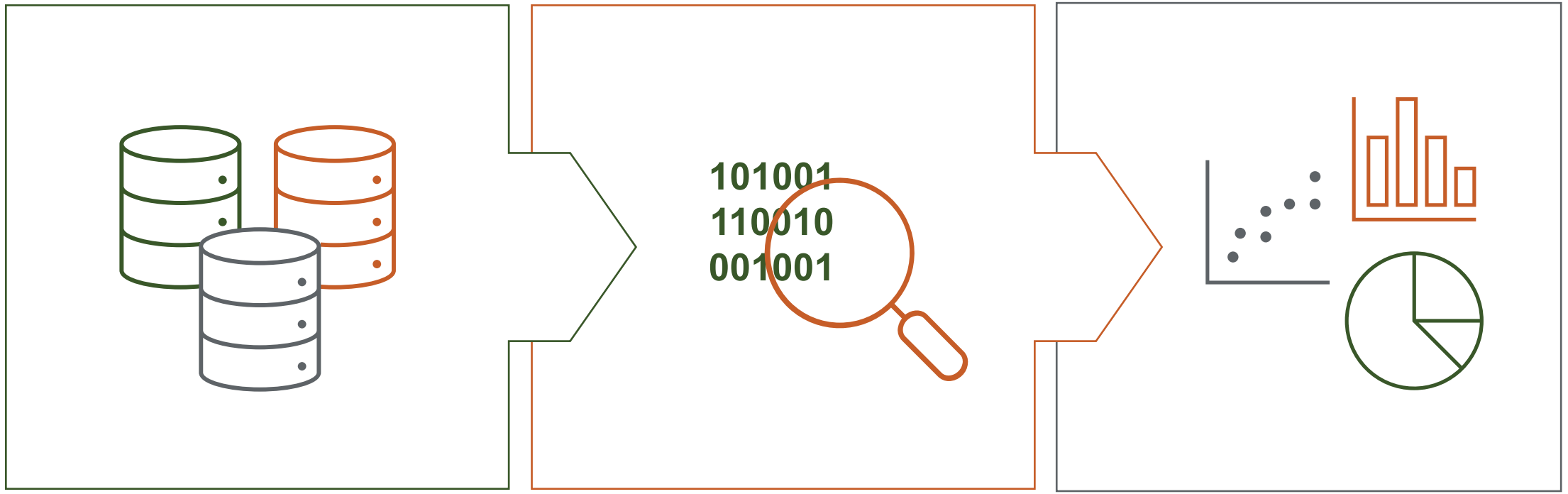
-BERCKMANS & AERTS (2006)

# Equipment

# Collaboration

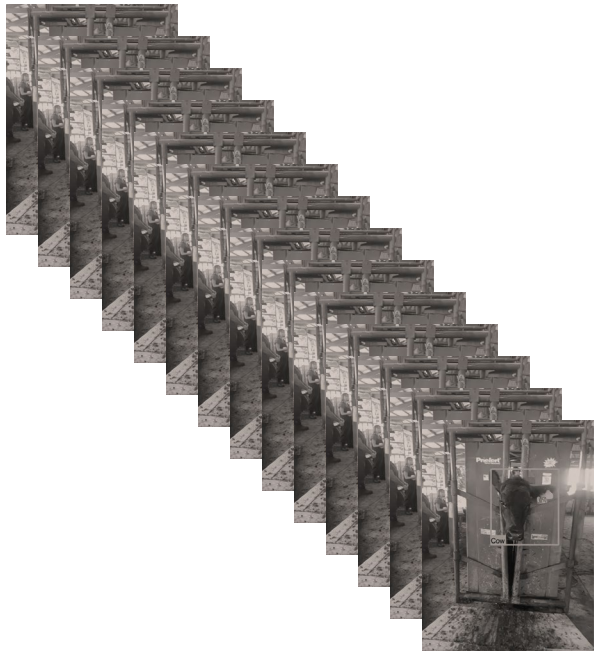

“
Measure what is important. Don’t make important what you can measure.
- ROBERT MCNAMARA

# Data



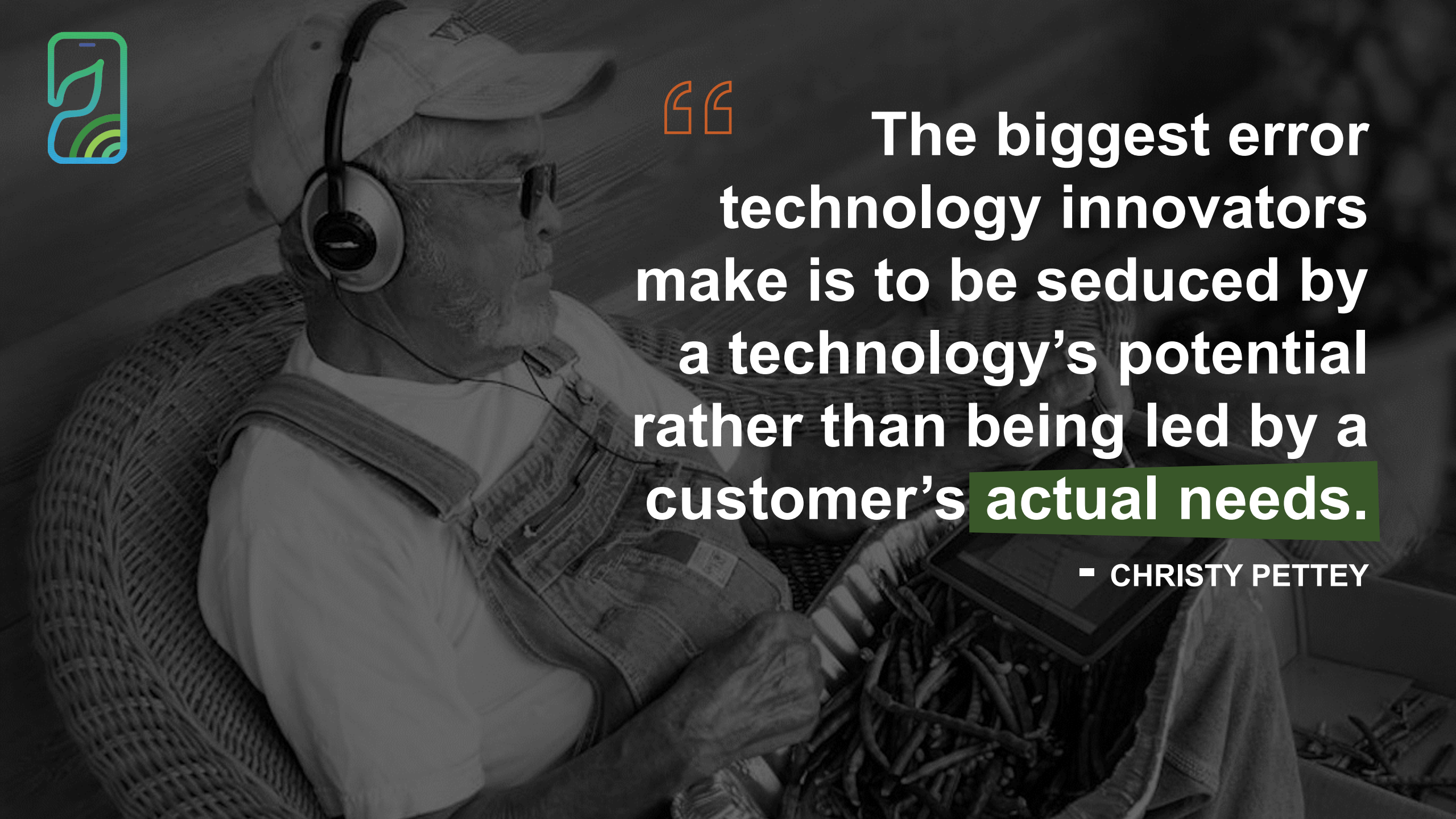
# Big Data


**IMAGE**
584 X 648 px = 378, 432 numbers
140 KB

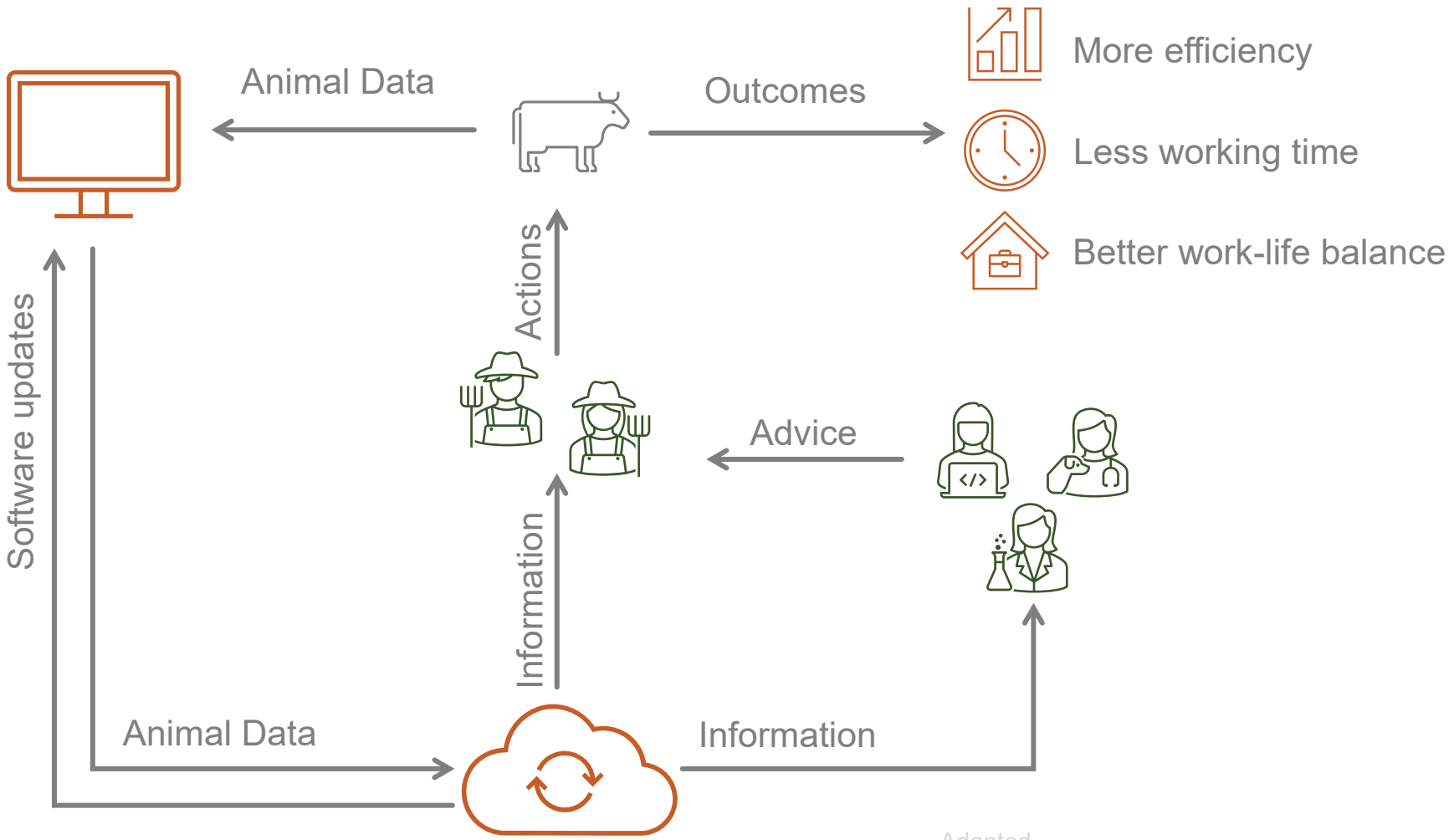


**30 IMAGES/SEC**
11,352,960 numbers/sec
4.2 MB/sec

**24h**
980,895,744,000
**Animal weight**
1 number
362.88 GB

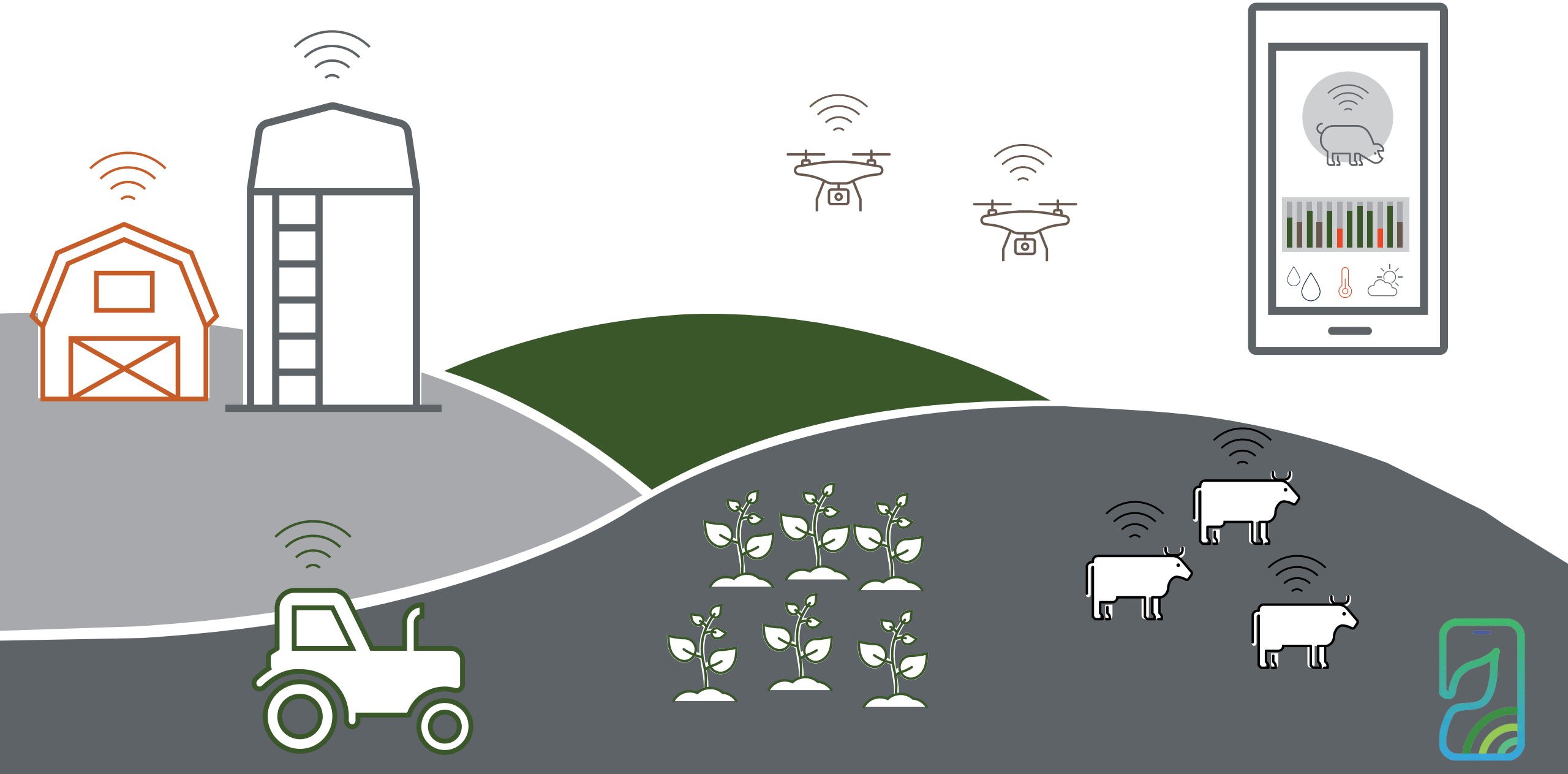

“
The biggest error technology innovators make is to be seduced by a technology’s potential rather than being led by a customer’s actual needs.
- CHRISTY PETTEY

# Data Integration




Adapted from 4D4F

# Farm of the future



Illinois Digital
Animal Systems Lab

Dr. Isabella Condotta

*Assistant Professor*
Department of Animal Sciences

icfsc@illinois.edu

(217) 244-0873

(402) 631-7669

College of Agricultural, Consumer & Environmental Sciences
UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

"THE BEST WAY TO PREDICT THE FUTURE IS TO CREATE IT."

-Peter Drucker

USDA

# i-farm.illinois.edu

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

I-FARM: Farm of the Future

Search this site

Home | About I-FARM | The I-FARM Team | I-FARM University | I-FARM News


## About us

I-FARM stands for "Illinois Farming and Regenerative Management." This University of Illinois-led study — funded for three years and $3.9M by the U.S. Department of Agriculture's National Institute of Food and Agriculture (NIFA) — is developing an 80-acre agricultural testbed, where commodity crops, cover crops, and livestock are farmed using synergistic, sustainable practices.

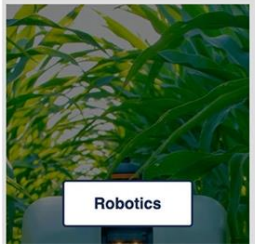
The I-FARM testbed features improved precision farming with remote sensing; new autonomous solutions for cover-crop planting, variable-rate input applications, and mechanical weeding; and artificial intelligence-enabled remote sensing for animal health prediction, nutrient quantification, and soil health.

## Videos from the field

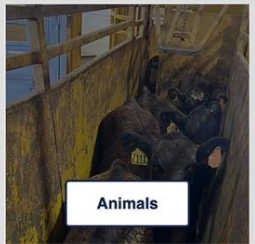

A full I-FARM video playlist may be found on YouTube >>>

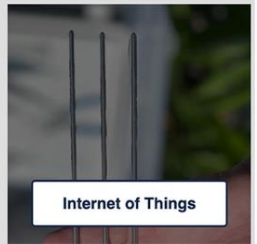
## I-FARM University: Passing on the knowledge!

I-FARM will demonstrate new technologies, data-driven products, and services for farmers and industry, easing adoption and opening new markets.








# go.illinois.edu/ifarmupdates

Subscribing to: I-FARM Updates

I-FARM stands for "Illinois Farming and Regenerative Management." This University of Illinois-led study — funded for three years and $3.9M by the U.S. Department of Agriculture's National Institute of Food and Agriculture (NIFA) — is developing an 80-acre agricultural testbed, where commodity crops, cover crops, and livestock are farmed using synergistic, sustainable practices.

The I-FARM testbed features improved precision farming with remote sensing; new autonomous solutions for cover-crop planting, variable-rate input applications, and mechanical weeding; and artificial intelligence-enabled remote sensing for animal health prediction, nutrient quantification, and soil health.

**Join our mailing list to receive the latest updates on the I-FARM project. This includes research, events and extension programming.**

I'm not a robot

reCAPTCHA
Privacy - Terms

**Email** *

**Re-enter email** *

First Name *

Last Name *

Subscribe

Thank you for joining our mailing list.

# farmdoc Sponsors

TIAA | Center for Farmland Research

CoBANK

COMPEER FINANCIAL

CORTEVA™ agriscience

FARM CREDIT ILLINOIS
Helping Farm Families Succeed

FS GROWMARK

ILCORN WWW.ILCORN.ORG

ILLINOIS SOYBEAN ASSOCIATION

# farmdoc
# Educational Partners

College of Agricultural, Consumer & Environmental Sciences
UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

Department of
Agricultural & Consumer Economics

Illinois Extension

Gardner Agriculture Policy Program

FBFM

# 2024 farmdoc Webinar

## Thank You for joining us!

Visit us at

**farmdocDAILY**
**.Illinois.edu**

Subscribe for Latest News Updates

**College of Agricultural, Consumer & Environmental Sciences**
UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

YouTube

**For the webinar archives and 5-minute farmdoc**
**Subscribe to our channel YouTube.com/@farmdoc**

5 minute farmdoc